



SEA VIEWS

MIMA'S ONLINE COMMENTARY ON MARITIME ISSUES

No. 5/2017

15 Dec 2017

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Marine Plastic Pollution and Fisheries: Making sense of the environmental issue and implications

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The authors discuss the issue of coastal and marine debris, with a focus on plastics and its impact on fisheries. The coastal cleanliness assessment tool adopted by MIMA in assessing pilot coastal areas in Malaysia is elaborated. Further, pointers from a recent paper delivered on the subject at the Network of East Asia Think-Tanks (Neat) Working Group on Water Pollution held in Jakarta are re-emphasised in assessing the issue.

Introduction

Marine litter, or marine debris and marine garbage, is among the major threats to the world's oceans. It includes solid materials of human origin that are discarded at sea or reaches the sea through waterways or domestic and industrial outfalls. Marine debris enters the seas from both land-based sources and from vessels at sea, and comprises a wide range of materials, such as persistent plastics, lost and abandoned fishing gear, and a variety of other pollutants. It contributes to a wide range of ecological, environmental and socio-economic impacts, including ingestion by and entanglement of marine life, fouling of coastlines and interference with navigation. There have been cases of major shipping accidents, resulting in loss of human life,

from the entanglement of vessel propellers and rudders in marine debris. Public health issues are also associated with hazardous materials, medical wastes, syringes, glass, and other debris washed-up on beaches. Global data shows increasing levels of garbage washing up on coastlines and accumulating at sea. Estimates by the US Academy of Sciences place total annual global input of marine debris into the oceans at approximately 6.4 million tonnes, and it is estimated that there are over 46,000 pieces of plastic per square mile of ocean today. It has been suggested that an estimated three times more garbage (much of it plastic) is discarded into the oceans each year than the amount of fish taken out.

A Fisheries and Aquaculture Technical Paper published this year by the Food and Agriculture Organisation of the United Nations (FAO) shows that plastic production has increased exponentially since the early 1950s and is expected to continue this trend in the foreseeable future with production levels likely to double by 2025. Inadequate management of plastic waste has led to increased contamination of the estuarine and marine environments. It has been estimated that in 2010 between 4.8 million to 12.7 million tonnes of plastic waste entered the oceans. Abandoned, lost or otherwise discarded fishing gears are considered the main source of plastic waste by the fisheries sector, but their relative contribution is not well known.

Microplastics are defined as plastic items which measure less than 5 mm. They may be manufactured within this size range or result from the degradation and fragmentation of larger plastic items. Microplastics enter aquatic environments through different pathways and have been reported in almost all environmental areas e.g., beaches, sediments, surface waters, and water columns. Their ingestion by aquatic organisms, including species of commercial importance for fisheries, has been documented. More specifically in humans the risk of microplastics ingestion is increased through the consumption of bivalves and several species of small fish that are consumed whole. It is projected that microplastics contamination will continue to increase in the foreseeable future. There are however knowledge gaps on the occurrence in the environment and organisms as well as their possible effects on seafood safety.

The global scenario

The Global Oceans Action Summit for Food Security and Blue Growth in 2014 emphasised the need for the FAO, the International Maritime Organisation (IMO) and the United Nations Environment Programme (UNEP) to work with the Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) to improve the knowledge base on microplastics in the marine environment and provide policy advice based on a global assessment on their sources, fate, and impacts. More specifically, the FAO undertook work on fisheries and aquaculture with a focus on two concerns i.e., to assess the potential impact of microplastics on consumer health and perception, and understand the potential consequences on fish productivity as physiological processes are likely to be affected by them. Samples collected and scientific literature increasingly and clearly show occurrence of microplastics in fish and shellfish as well as in fisheries and aquaculture products.

Data show that over 150 million tonnes plastic have been reported to be floating globally in the ocean. Since plastic can remain in the ocean for hundreds of years, recent literature shows that plastic leakages is currently up to 8 million tonnes a year and could easily leak into the ocean and further degrade the marine ecosystems. With no action taken now, in 2050 there will be more plastic than fish(!) The total economic impact of plastic leakage is however still unclear. The World Economic Forum in 2016 highlighted that the plastic leakages could economically cost up to

US\$695 million annually for coastal and beach cleaning, while excluding other potential impacts on human livelihoods and health that require further assessments.

In terms of the global contribution, China makes up about 30 percent of the global plastic pollution in the ocean. Malaysia is ranked eighth among the top ten worst polluters i.e., China, Indonesia, the Philippines, Vietnam, Sri Lanka, Thailand, Egypt, Nigeria, and Bangladesh. Findings convey the message that ocean pollution is not a single country issue as debris pollution is a result of low awareness within individuals in maintaining cleanliness, while the origin of marine pollution shows that the distribution vary due to monsoonal factors in the region.

Situation in Malaysia

The Malaysian government spent about RM950 million to manage solid waste under the Ninth Malaysia Plan (RMK9) alone. According to the Malaysian Plastics Manufacturers Association, the plastic industry in Malaysia had grown by almost 10 percent annually with the possibility of further growth and development. While the boom in export of plastic products has increased to RM13.9 billion, the recycling rate in Malaysia is at 17.5 percent in comparison to the national recycling target of 22 percent by 2020.

Malaysia's coastal areas are characterised by a rich diversity of natural, environmental, cultural and economic resources and is among the country's most valuable assets. However, the quality has deteriorated as a result of marine debris. Although currents and winds can be responsible for the deposition of waste from outside on the coastal areas, over half the debris is left behind by vacationers and bathers. Together with human interference, plastic leakages are seen as one of the key factors contributing to the killing of wild live and beach pollution, and a threat to food security. Despite this, studies on fisheries and plastic leakages in Malaysia are lacking. Overall, however, both fishing and recreational beaches have been found to be more polluted when the increasing number of visitors are not supported with regular cleaning and sufficient disposal facilities.

Assessment and gaps encountered

Although some work has been done on assessing the extent of marine litter, the National Survey on Marine Litter for East Asian Seas conducted by the United Nations Environment Programme (UNEP), the East Asian Seas Regional Coordinating Unit (EAS/RCU), in collaboration with the EcoStrategic Consultants in September 2006 has highlighted the following gaps:

- Surveys and monitoring: Lack of systematic surveys or monitoring of the marine litter problem in the country.
- Source differentiation: No data on marine litter in the country differentiating/identifying its sources (e.g., the balance between land- and ship-based sources).
- Accumulation zones: No information on ocean circulation patterns and accumulation zones for marine litter in the country's waters and along the coastlines.
- Ecological and environmental impacts: Anecdotal information on derelict fishing gears collected by the Department of Fisheries vessels while on patrol. These gears will continue to ghost fishing, cause wildlife entanglement, and foul vessel propellers. There have been several newspapers articles on turtle strangling on derelict fishing gears and chocking on plastic.

In addition, the study on 'Marine Tourism in Malaysia: Assessing Potentials and Avoiding Pitfalls' conducted by MIMA earlier also highlighted that 95 percent of the coastal sites visited had litter issues.

A study in 2011 by the Ministry of Urban Wellbeing, Housing and Local Government on Plastic Management in Peninsular Malaysia revealed that more than 40 percent of the plastic market segments are highly concentrated in plastic packaging comprising bags, containers, films, plates, sheets, foils, strip bottles and boxes. Another study highlighted that the recycling rate in Malaysia is comparatively lower than its neighbouring countries despite the fact that 70 - 80 percent of the waste is recyclable.

While plastic is characterised as durable to safely contain food and for other pharmaceuticals purposes, its ability to accumulate other environmental pollutants such as metals and fertilisers would insidiously affect human health. Besides poisoning marine wild life, the chemical is equally harmful to health as 60 percent of protein intake among Malaysian is sourced from marine resources. Further the demand for fish in Malaysia is expected to increase to 1.9 million metric tonnes by 2020 as fish consumption per capita rises from 46kg to 55kg per year. However, the search for a healthier source of protein might be hampered as low recycling rates among Malaysians cause blockages to rivers and the ocean.

As more plastics leak into the ocean and remain trapped for a long time, the effect of global warming further accelerates their breakdown into smaller particles. In a situation where fish or other polluted marine wildlife are mistakenly consumed as plankton or meal, the chemicals will be transmitted into the tissues of fish. As such, reducing marine pollution of all kinds particularly from land-based activities is part of the United Nation Sustainable Development Goals (SDGs) agenda under Goal 14.

In the national effort to achieve a 22 percent recycling rate target in 2020, a 40 percent reduction of waste disposal into landfills and other possible dumping sites, including waste leakages have to be met. To increase the recycling rate among Malaysian, numerous campaigns have been conducted such as the National Recycling Day celebrated on 11th November, the 3R campaign, and the 'No Plastic Bags' on Saturdays where shoppers requesting plastic bags are charged RM0.20 per bag. Although not legally binding, some states have extended the awareness campaign to three to seven days a week in the effort to meet the recycling target.

Assessment and monitoring efforts

The magnitude and the extent of the debris problem in the marine environment have been highlighted by both beach and oceanic surveys. Beach surveys are the most-widely used method for monitoring marine debris as they are more economical than oceanic surveys, less constrained by weather and sea conditions, require little equipment, and can be conducted effectively by trained volunteers. Such surveys provide both qualitative and quantitative information on the composition, amounts, and sources of debris in various parts of the world, including the Caribbean, the Mediterranean, South Africa, and the United Kingdom.

For many years there was no accepted index of whether a beach was clean or dirty, the only measure being the amount of waste removed from the beach. Success of cleaning operations was measured by the tonnage of debris cleared or the number of trash bags collected, for example by the Ocean Conservancy. The parameters mentioned above are comparable and easily measured although they do emphasise the cleanup operation, rather than the real cleanliness of the beach.

MIMA established the clean-coast index (CCI) through a study in 2010-2011 as a tool for evaluation actual coast cleanliness. The index measures plastic debris as a beach cleanliness indicator in an easy manner that also avoids assessor's bias. As reported, plastic debris represents by far the major component of beach debris. The CCI has proven to be a useful tool for measuring progress and the success of activities such as education campaigns, media coverage, and enforcement actions.

The Index is then categorised as the following based on amount and types of debris collected from the surveyed coastal areas.

Coast Index	Very Clean	Clean	Moderate	Dirty	Extremely Dirty
Numeric Index	0-2	2-5	5-10	10-20	+20

The pilot study conducted by MIMA included selected coastal areas (beaches) in the country i.e., Morib and Kelanang (Selangor), Desaru (Johor), Cenang (Langkawi), Balok (Pahang), Puteri (Malacca), Tanjung Tuan and Cermin (Port Dickson), Puteri (Sarawak), and Tanjung Tuan (Sabah). It focused on plastic debris as an indicator for the application of the CCI due to the longevity of plastics life span before it degrades and the impact it imposes on marine lives. The term 'plastic' here includes any artificial waste made, or partly made, of plastic, including nylon fishing lines, styrofoam remains, plastic bags in all sizes, polyurethane sheets, bottles and bottle cap, cigarette box and outer cover and include any items exceeding 2 cm in size as the index numerator.

The survey showed that plastic is the major contributor to coastal debris comprising 66 percent of overall debris collected. The CCI managed to pinpoint the amount, composition, and distribution of coastal debris in the sampling survey.

Based on the established baseline CCI for the sampled recreational sites, Pantai Cenang in Langkawi recorded the lowest index at 1.08 indicating that the beach is very clean of plastic debris. Meanwhile, Pantai Desaru in Johor had the highest index at 7.11 indicating that the beach had more plastic pollution recorded. The data could provide description of the condition of the coastal areas in Malaysian and hence become a tool to evaluate the cleanliness of these areas. Additionally, publishing and updating the index every month or on a quarterly basis would create transparency on actual coastal cleanliness in the country especially of recreational beaches. This will influence the designated concessionaires to be more competitive in their tasks of maintaining the cleanliness of the areas under their jurisdictions.

Moving forward

The sources of these undesirable coastal contaminants are either land- or marine-based. Managing and preventing, or at least reducing, the problems created by marine debris are *difficult* to address as the volumes of debris involved are ever increasing. As a measurement tool, the CCI generates enough baseline data to indicate areas that need prioritising to ensure efforts and investments in coastal cleanliness are maximised. It also provides an easy tool for enforcement bodies in assessing and managing the cleanliness levels of their jurisdictions. MIMA seeks to encourage its use as it is simple for wide application and can be replicated over the long-term, as well as in formulating appropriate management strategies for addressing coastal debris management.

Following on the emerging concerns on microplastics and healthy food, advocating that plastic should not end up in the oceans or other water bodies can bring a significant reduction of waste generation. A problem involving high contamination of pollutant in water bodies can be resolved by identifying the sources. Farming ponds need to be monitored constantly to ensure the water quality does not exceed the permissible level for human consumption.

Also, creating an effective 'after-use plastic economy' could be the way forward to drastically reduce plastic leakages while sustainably conserving marine resources. Coastal cities have to be equipped with an integrated recycling facilities to improve disposal facilities, to minimise landfill loads, and to move up the plastic value chain which is not only limited to single use purpose.

Malaysia's Green Growth Strategy is a major initiative aimed at driving sustainable development and ensuring growth across generations. Similar to the principles of a circular economy, sustainable consumption and production (SCP) in Malaysia will be key to achieving the green growth agenda and addressing environmental challenges including preventing plastic leakages into marine ecosystems. In this regard, more scientific research on marine pollution and threat to human health is strongly needed. This is due to the fact that, the literature on plastic debris and microplastics is currently scarce and hurdling effort to incorporate the assessment of natural and anthropogenic factors on fisheries management. While Malaysia will continue with its national planning through existing government budgets and mechanisms, it is important that additional funding and other future collaborations for mobilising resources be further enhanced.